$$= \frac{1.501 \times 10^{-3} \times T_e}{P_B \times V_E} \times \left[\left(C_{S1} \times AV_1 \right) + \left(C_{S2} \times AV_2 \right) \right]$$

(iv) V = Enclosure volume, ft³ (m³), as measured in paragraph (b)(1) of this section.

(v) r = FID response factor to methanol.

(vi) P_B = Barometric pressure, in. Hg (kPa).

(vii) T = Enclosure ambient temperature, °R(°K).

(viii) i = Indicates initial reading.

(ix) f = Indicates final reading.

(x) (A) k = 3.05

(B) *For SI units,* k = 17.60

NOTE: Hydrocarbon concentration is stated in ppm carbon, that is, ppm propane × 3. Expressions in parentheses are for SI units.

[54 FR 14564, Apr. 11, 1989, as amended at 60 FR 34359, June 30, 1995]

§86.1217–96 Evaporative emission enclosure calibrations.

The calibration of evaporative emission enclosures consists of three parts: initial and periodic determination of enclosure background emissions (hydrocarbons and methanol); initial determination of enclosure internal volume; and periodic hydrocarbon and methanol retention check and calibration. Methanol measurements may be omitted if methanol-fueled vehicles will not be tested in the evaporative enclosure. Alternate calibration methods may be used if shown to yield equivalent or superior results, and if approved in advance by the Administrator; specifically, more extreme temperatures may be used for determining calibration without affecting the validity of test results.

(a) *Initial and periodic determination of enclosure background emissions.* Prior to its introduction into service, annually thereafter, and after any repair that can affect the enclosure background emissions, the enclosure shall be checked to determine that it does not contain materials that will themselves emit hydrocarbons or methanol. When methanol as well as hydrocarbons are present in the evaporative enclosure, the HFID hydrocarbon concentration measurement includes the partial response of the HFID to methanol plus the hydrocarbons. Determination of the HFID response to methanol, §86.1221, prior to its being placed in service is required for the determination of hydrocarbons. Proceed as follows:

(1) Prepare the enclosure. (i) Variable-volume enclosures may be operated in either latched or unlatched volume configuration, as described in paragraph (b)(1) of this section. Ambient temperatures shall be maintained at 96±3 °F throughout the 4-hour period.

(ii) Fixed-volume enclosures may be operated with inlet and outlet flow streams either closed or open; if inlet and outlet flow streams are open, the air flowing into and out of the enclosure must be monitored in accordance with §86.107–96(a)(1)(ii)(B). Ambient temperatures shall be maintained at 96±3 °F throughout the 4-hour period.

(iii) For running loss enclosures ambient temperatures shall be maintained at 95±3 °F throughout the 4-hour period. For running loss enclosures designed with a vent for makeup air, the enclosure shall be operated with the vent closed.

(2) The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the 4-hour background sampling period begins.

(3) Zero and span (calibrate if required) the hydrocarbon analyzer.

(4) Prior to the background determination, purge the enclosure until a stable background hydrocarbon reading is obtained.

(5) Turn on the mixing blower (if not already on).

(6) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, and P_{Bi}, T_i for the enclosure background determination.

(7) Allow the enclosure to stand undisturbed for four hours.

(8) Measure the hydrocarbon concentration on the same FID and the methanol level. These are the final concentrations, C_{HCf} and C_{CH_3OHf}. Also measure final temperature and barometric pressure.

(9) Calculate the mass change of methanol, hydrocarbons, and hydrocarbons plus methanol in the enclosure according to the equations in paragraph (d) of this section.

(i) *Diurnal enclosures.* The enclosure background emissions (hydrocarbons plus methanol) shall not be greater than 0.05g for the 4 hours.

(ii) *Running loss enclosures.* The enclosure background emissions (hydrocarbons plus methanol) shall not be greater than 0.2 grams for the 4 hours.

(b) *Initial determination of enclosure internal volume.* Prior to its introduction into service the enclosure internal volume shall be determined by the following procedure:

(1) Carefully measure the internal length, width and height of the enclosure, accounting for irregularities (such as braces) and calculate the internal volume. For variable-volume enclosures, latch the enclosure to a fixed volume when the enclosure is held at a constant temperature; this nominal volume shall be repeatable within ±0.5 percent of the reported value.

(2)–(3) [Reserved]

(c) *Hydrocarbon and methanol (organic gas) retention check and calibration.* The hydrocarbon and methanol (if the enclosure is used for methanol-fueled vehicles) retention check provides a check upon the calculated volume and also measures the leak rate. The enclosure leak rate shall be determined prior to its introduction into service, following any modifications or repairs to the enclosure that may affect the integrity of the enclosure, and at least monthly thereafter. If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

(1) An enclosure to be used for the diurnal emission test (see § 86.1233–96) shall be calibrated according to the following procedure. Calibration for hydrocarbon and methanol may be con-

ducted simultaneously or in sequential test runs.

(i) Zero and span (calibrate if required) the hydrocarbon analyzer.

(ii) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(iii) Turn on the mixing blowers (if not already on).

(iv) [Reserved]

(v) Turn on the ambient temperature control system (if not already on) and adjust it for an initial temperature of 96 °F (36 °C). On variable-volume enclosures, latch the enclosure to the appropriate volume position for the set temperature. On fixed-volume enclosures close the outlet and inlet flow streams.

(vi) When the enclosure stabilizes at 96±3 °F (36±2 °C), seal the enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, T_i, and P_{Bi} for the enclosure calibration.

(vii) Inject into the enclosure 2 to 6 grams of pure methanol at a temperature of at least 150 °F (65 °C) and/or 2 to 6 grams of pure propane. The injected quantity may be measured by volume flow or by mass measurement. The method used to measure the quantity of methanol and propane shall have an accuracy of ±0.2 percent of the measured value (less accurate methods may be used with the advance approval of the Administrator).

(viii) After a minimum of 5 minutes of mixing, analyze the enclosure atmosphere for hydrocarbon and methanol content, also record temperature and pressure. These measurements are the final readings for the enclosure calibration as well as the initial readings for the retention check.

(ix) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in paragraphs (c)(1)(vi) and (viii) of this section. See paragraph (d) of this section. This quantity must be within ±2 percent of that measured in paragraph (c)(1)(vii) of this section. (For calendar years through 1995, the difference may exceed ±2 percent for methanol, provided it does not exceed ±6 percent.)

(x) For variable-volume enclosures, unlatch the enclosure from the nominal volume configuration. For fixed-volume enclosures, open the outlet and inlet flow streams.

(xi) Start cycling the ambient temperature from 96 °F to 72 °F and back to 96 °F over a 24-hour period, according to the profile specified in §86.1233–96 and appendix II of this part, within 15 minutes of sealing the enclosure.

(xii) At the completion of the 24-hour cycling period, analyze the enclosure atmosphere for hydrocarbon and methanol content; determine the net withdrawn methanol (in the case of diurnal emission testing with fixed-volume enclosures); record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check. The final hydrocarbon and methanol mass, calculated in paragraph (d) of this section, shall be within 3 percent of that determined in paragraph (c)(1)(viii) of this section. (For calendar years through 1995, the difference may exceed ±3 percent for methanol, provided it does not exceed ±6 percent.)

(2) An enclosure to be used for the running loss test (see §86.1234–96) shall meet the calibration and retention requirements of §86.1217–90(c).

(3) Enclosures calibrated according to the procedures specified in either paragraph (c)(1) or (c)(2) of this section may

be used for hot soak testing (see §86.1238).

(4) The Administrator, upon request, may waive the requirement to comply with ±2 percent methanol recovery tolerance, and/or the ±3 percent retention tolerance and instead require compliance with higher tolerances (not to exceed ±6 percent for recoveries and ±8 for retention), provided that:

(i) The Administrator determines that compliance with these specified tolerances is not practically feasible; and

(ii) The manufacturer makes information available to the Administrator which indicates that the calibration tests and their results are consistent with good laboratory practice, and that the results are consistent with the results of calibration testing conducted by the Administrator.

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, the net withdrawn methanol (in the case of diurnal emission testing with fixed-volume enclosures), and initial and final temperature and pressure according to the following equation:

$$M_{CH_3OH} = V_n \times \left[\frac{(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})}{V_{E_f}} \right] - \left[\frac{(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})}{V_{E_i}} \right] + (M_{CH_3OH,out} - M_{CH_3OH,in})$$

Where:

(i) M_{CH3OH}=Methanol mass change, µg.

(ii) V=Enclosure volume, ft³, as measured in paragraph (b)(1) of this section.

(iii) [Reserved]

(iv) [Reserved]

(v) V_E=Volume of sample withdrawn, ft³. Sample volumes must be corrected for differences in temperature to be consistent with determination of V_n, prior to being used in the equation.

(vi) P_B=Barometric pressure at time of sampling, in. Hg.

(vii) C_{MS}=GC concentration of test sample.

(viii) AV=Volume of absorbing reagent in impinger.

(ix) i=Initial sample.

(x) f=Final sample.

(xi) 1=First impinger.

(xii) 2=Second impinger.

(xiii) $M_{CH3OH,out}$=mass of methanol exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, µg.

(xiv) $M_{CH3OH,in}$=mass of methanol entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, µg.

(2) The hydrocarbon mass change is calculated from the initial and final FID readings of hydrocarbon concentration, methanol concentration with FID response to methanol, temperature, and pressure according to the following equation:

$$M_{HC} = kV \times 10^{-4} \frac{\left(C_{HCf} - rC_{CH3OHf}\right)}{T_f} \times P_{BF} - \frac{\left(C_{HCi} - rC_{CH3OHi}\right)}{T_i} \times PBi$$

Where:

(i) M_{HC}=Hydrocarbon mass change, g.

(ii) C_{HC}=FID hydrocarbon concentration as ppm carbon including FID response to methanol in the sample.

(iii) C_{CH3OH}=Methanol concentration as ppm carbon

$$= \frac{1.501 \times 10^{-3} \times T_e}{P_B \times V_E} \times \left[\left(C_{S1} \times AV_1\right) + \left(C_{S2} \times AV_2\right)\right]$$

(iv) V=Enclosure volume ft³ (m³), as measured in paragraph (b)(1) of this section.

(v) r=FID response factor to methanol.

(vi) P_B=Barometric pressure, in. Hg. (kPa).

(vii) T=Enclosure ambient temperature, R(K).

(viii) i=Indicates initial reading.

(ix) f=Indicates final reading.

(x)(A) k=3.05.

(B) For SI units, k=17.60.

(xi) $M_{HC,out}$=mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.

(xii) $M_{HC,in}$=mass of hydrocarbon entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.

(3) For variable-volume enclosures, defined in §86.1207(a)(1)(i), the following simplified form of the hydrocarbon mass change equation may be used:

$$M_{HC} = \left(\frac{kP_B V_n \times 10^{-4}}{T}\right) \times \left[\left(C_{HC_f} - rC_{CH_3OH_f}\right) - \left(C_{HC_i} - rC_{CH_3OH_i}\right)\right]$$

(e) *Calibration of equipment for point-source testing of running losses.* For the point-source method, the running loss fuel vapor sampling system shall be calibrated as a CVS system, as specified in §86.119, with the additional specification that the vapor sampling system verification be conducted as follows:

(1) The following "gravimetric" technique can be used to verify that the vapor sampling system and analytical instruments can accurately measure a mass of gas that has been injected into the system. If the vapor sampling system will be used only in the testing of petroleum-fueled engines, system verification may be performed using propane. If the vapor sampling system will be used with methanol-fueled vehicles as well as petroleum-fueled vehicles, the system verification performance check must include a methanol check in addition to the propane check. (Verification can also be accomplished

by constant flow metering using critical flow orifice devices.)

(i) Obtain a small cylinder that has been charged with pure propane gas. Obtain another small cylinder that has been charged with pure methanol if the system will be used for methanol-fueled vehicle testing. Since this cylinder will be heated to 150–155 °F, care must be taken to ensure that the liquid volume of methanol placed in the cylinder does not exceed approximately one-half of the total volume of the cylinder.

(ii) Determine a reference cylinder weight to the nearest 0.01 grams.

(iii) Operate the vapor sampling system in the normal manner and release a known quantity of pure propane into the most frequently used fuel vapor collector during the sampling period (approximately 5 minutes).

(iv) Continue to operate the vapor sampling system in the normal manner and release a known quantity of pure methanol into the system during the sampling period (approximately 5 minutes).

(v) The calculations of §86.1244 are performed in the normal way, except in the case of propane. The density of propane (17.30 g/ft³/carbon atom (0.6109 kg/m³/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of methanol, the density of 37.71 g/ft³ (1.332 kg/m³) is used.

(vi) The gravimetric mass is subtracted from the vapor sampling system measured mass and then divided by the gravimetric mass to determine the percent accuracy of the system.

(vii) The cause for any discrepancy greater than ±2 percent must be found and corrected.

(2) This procedure shall be conducted in the point-source running loss test environment with the collector installed in a vehicle in the normal test configuration. The fuel of the test vehicle shall either be diesel, or it shall be kept under 100 °F (38 °C). Two to six grams of pure propane and two to six grams of pure methanol shall be injected into the collector while the vehicle is operated over one Heavy-Duty Vehicle Urban Dynamometer Driving Schedule, as described in §86.1215 and appendix I of this part. The propane and methanol injections shall be conducted at the ambient temperature of 95±5 °F (35±3 °C).

[58 FR 16050, Mar. 24, 1993, as amended at 60 FR 34360, June 30, 1995; 60 FR 43900, Aug. 23, 1995]

§86.1218–85 Dynamometer calibration.

(a) The dynamometer shall be calibrated at least once each month or performance verified at least once each week and then calibrated as required. The calibration shall consist of the manufacturer's recommended calibration procedure plus a determination of the dynamometer frictional power absorption. If the dynamometer is to be used for driving only the reference (transient) schedule, the frictional power absorption needs to be determined only at 50.0 mph (80.5 km/hr). If the dynamometer is to be used for driving the steady-state cycle, the frictional power absorption needs to be determined through the range of 15 to 50 mph. One method for determining dynamometer frictional power absorption at 50.0 mph (80.5 km/hr) is described below. The same general method can be used at other speeds. Other methods may be used if shown to yield equivalent results. The measured absorbed road power includes the dynamometer friction as well as the power absorbed by the power absorption unit. The dynamometer is driven above the test speed range. The device used to drive the dynamometer is then disengaged from the dynamometer and the roll(s) is (are) allowed to coastdown. The kinetic energy of the system is dissipated by the dynamometer. This method neglects the variations in roll bearing friction due to the drive axle weight of the vehicle. In the case of dynamometers with paired rolls, the inertia and power absorption of the free (rear) roll may be neglected if its inertia is less than 3.0 percent of the total equivalent inertia required for vehicle testing.

(1) Devise a method to determine the speed of the roll(s) to be measured for power absorption. A fifth wheel, revolution pickup, or other suitable means may be used.

(2) Place a vehicle on the dynamometer or devise another method of driving the dynamometer.

161